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Nat Hist Surv

TOMATO INSECT CONTROL RECOMMENDATIONS

George F. Knowlton
Howard E. Dorst

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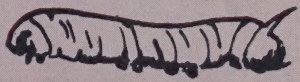

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Cutworm

Description—Cutworms range in color from dull gray and brown to black, and may be striped or spotted. When almost full grown, cutworms are stout, soft-bodied, smooth, and measure about 1¼ inches long. When disturbed they curl up tightly.

Damage—Cutworms cut off plants at or below the soil surface. Some feed on leaves, buds, or fruits; others feed on the underground portion of plants. They are particularly destructive to early-season plantings. They feed in the evenings and at night when temperatures permit insect activity.

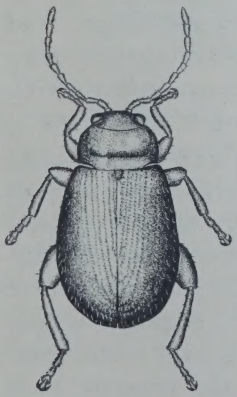
Control—Use poisoned bran bait, made by mixing 25 pounds of dry bran, 1 pound of sodium fluosilicate powder, and enough water (2 to 3 gallons) to moisten the mixture. The sodium fluosilicate powder should be thoroughly mixed with the bran before the water is added to insure its even distribution. This is enough bait to treat two to three acres of fence row, roadside, and garden area.

Scatter 25 to 30 pounds of the wet bait per acre in the evening. Bait approximately 1 week before tomato plants are to be set out. When land is broken from sod

or alfalfa, it should always be treated for cutworm control before tomatoes are planted. Make a second distribution of bait on the third evening following the first application. This treatment should destroy most common garden cutworms. If the bait is spread during cold or stromy weather it is less effective because cutworms are less active at such times.

Cutworm bait often can be bought ready mixed in small quantities, for home garden treatments. This bait is the same as that used later in the season to control grasshoppers.

A 10 percent DDT dust applied to the tomato plants and soil around the plant stems at the rate of 10 pounds per acre usually will give control nearly equal to the bait.



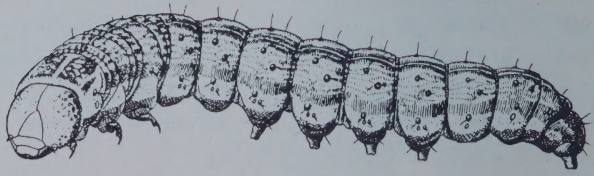
Flea Beetle

Description—Flea beetles may be black, brown, or striped, and are about 1/16 inch long.

Damage—Flea beetles attack many other vegetables besides tomatoes. Leaves of severely damaged young plants look as if they had been shot full of small holes.

Control—Apply a 5 or 10 percent DDT dust to the foliage before injury becomes serious.

Tomato Fruitworm



Description—When this insect is on corn, it is called the corn earworm. It may be green, brown, or pink. It has stripes along the back and sides. When full grown it may be 1¾ inches long. Eggs about half the size of a pin head are deposited singly mostly on the upper side of tomato leaves. The adult moth has a wing expanse of about 1½ inches and is light grayish brown marked with dark gray irregular lines.

Damage—Small worms hatch from the eggs, feed slightly on the leaves, and move to either ripe or green tomato fruits. The worm may shift from fruit to fruit. damaging many, burrowing, or making trial feedings.

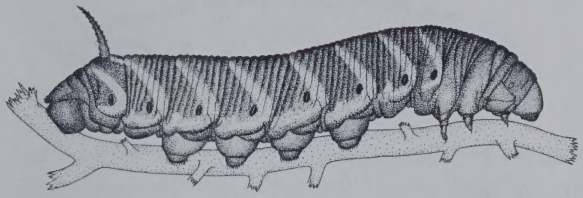
Control—When tomato fruitworm infestations are high, control measures are profitable. During many years infestations are slight and do not justify control applications. Information on the expected infestation is gathered each year by the United States Department of Agriculture and the Utah Agricultural Experiment Station entomologists. At least one egg of tomato fruitworm per 100 leaves at the time of the principal fruit

set is necessary before control measures are justified. Conclusions drawn from survey information are given to the county agents, canners, and the press and radio.

When infestations are expected to be heavy, the tomato fields should be thoroughly dusted with 10 percent DDT dust. (DDT spray is not recommended.) Make first applications when the main fruit set is ½ to 1 inch in diameter. Repeat the treatment two weeks later if the surveys indicate a persisting infestation.

If hornworms also are present, either this or 10 percent TDE will serve as a combination treatment.

Hornworm



Description—The hornworm is one of the best known tomato pests because of its large size. Full grown worms are 3 to 4 inches long, green, white-barred, with a slender horn projecting from near the rear end. The greenish yellow eggs are about three times the size of the tomato fruitworm egg and are deposited singly on the underside of leaves. The adult is a large swift-flying hawk-moth or humming-bird moth. It flies chiefly at dusk.

Damage—The worms feed ravenously on tomato leaves and may defoliate a tomato plant before moving on. Sometimes they also feed on the green fruits.

Control—When hornworm damage is noted, look for and destroy the worms. When the infestation is extensive, dust with 10 percent DDT as for the tomato fruitworm, using 20 to 30 pounds per acre. A 10 percent TDE dust also has given control of hornworms.

Yellow-Striped Armyworm

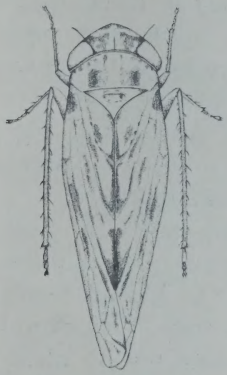
Description—The yellow-striped armyworm has two prominent and many fine yellow stripes on a velvety black background. The adults are gray or brown moths mottled with slate and buff markings. Eggs are laid in clusters, usually on weeds or adjacent alfalfa. The worms migrate to tomatoes from other crops.

Damage—The worms feed on tomato fruits, both ripe and green, but do not normally burrow into the fruit.

Control—Dust plants that are not to be used as food or feed along the field margins with 10 percent DDT or 10 percent toxaphene. This is to destroy worms mov-

ing in from adjacent lands. Apply 10 percent DDT dust as for tomato fruitworm to tomato plants if they become infested.

Beet Leafhopper



Description—The beet leafhopper is about 1/8 inch long and varies in color from pale green in the spring when the migration to tomatoes is made, to dark brownish in the hibernating adults. The eggs are deposited in plant stems. The young resemble the adult but are smaller and do not have wings.

Damage—The adult beet leafhopper appears in varying numbers in tomato fields as a result of movements from desert breeding grounds. It causes damage by the transmission of the virus disease called curly top or western yellow blight. The insect does not breed on tomato plants and remains in clean cultivated tomato fields only a short period during the course of migration. The disease is transmitted during this period. Curly top may kill tomato plants and it causes fruit to ripen prematurely.

Control—Available insecticides have not been sufficiently effective to kill the leafhopper before feeding occurs on tomatoes.

Whenever the beet leafhopper situation appears threatening, as was the case in 1952, losses from curly-top can be materially reduced by doubling the stand within the row or by planting two tomato plants approximately six inches apart in each hill.

DDT 10 percent dust, when applied in three applications at 10 day intervals, the first application soon after transplanting in mid-May, has reduced the curly top disease about 50 percent. Keep tomato fields free from weeds throughout the growing season and particularly during mid-May through mid-June. Many weeds support and attract the beet leafhopper.

Information on the anticipated infestation of beet leafhopper is given to all county agents and canners, and is released through the press by the United States Department of Agriculture and Utah State Agricultural College entomologists each spring before tomato planting time. The intensity of the leafhopper migration is governed by the size of the overwintering population and acreage of host plants in the southern desert breeding grounds and the local areas adjacent to Great Salt Lake and Utah Lake.

Tomato Russet Mite

Description—The tomato russet mite is so tiny it cannot be seen by the naked eye. Under magnification it is light amber colored and tear-drop shaped. When a

great many are present on tomatoes, the foliage develops a russet-like appearance.

Damage—When present in large numbers, mites cause the lower leaves to turn brown, curl, and finally die. The exposed fruits become sun-scalded, resulting in poor grade. If the mites are not controlled, the plants die.

Control— It is believed that the tomato russet mite does not overwinter under natural conditions in Utah. All tomato seedlings should have been dusted with sulfur before being shipped into Utah. Most seasons this mite has appeared only in small spots in the field. However, when left uncontrolled, it has spread through the field and to surrounding fields. Apply fine-mesh dusting sulfur at the rate of 20 to 30 pounds per acre. Treat all affected and adjacent areas. Sulfur should be applied at the first sign of injury.

Grasshopper

Description—Grasshoppers vary in color from brown, gray, and black to yellow. They are up to 2 inches in length. They have strong hind legs for jumping and many grasshoppers are strong flyers.

Damage—Grasshoppers feed on tomato foliage. However, the principal damage is to the fruit.

Control Control grasshoppers to protect ripening tomato fruits from injury. Destroy the grasshoppers dur-

ing spring and summer by making early morning applications of poisoned bait as often as necessary. The bait is prepared and used for grasshopper control in the same manner as that described for cutworms, page 2.

Many grasshoppers can be killed in the marginal areas of fields on plants not to be used for food or feed, by spraying in the spring with toxaphene, aldrin, or heptachlor. Control measures should be taken as soon as the grasshopper nymphs have hatched and before they move into the field areas.

Drosophila Fly or Vinegar Gnat

Description—The adult *Drosophila* fly is about 1/8 inch long, yellowish in color, and clear winged. Eggs are laid on cracks of fruit when the protective skin has been broken. The worms that hatch are 1/16 inch long but grow to about ¼ inch.

Damage—Eggs deposited on cracks of tomato fruits in the field may hatch before the fruit has been processed. The presence of eggs or larvae on fruit may cause the product to be condemned at the receiving station. If processed, the contaminated product may be subject to seizure.

Control—Remove weeds from tomato fields. Weeds provide shade for *Drosphila* fly feeding. Correct or eliminate all farm operations which produce crushed fruit. Avoid holding picked tomatoes in the field. Speed up

marketing after the fruit has been picked. Control grasshoppers, hornworms, fruitworms, armyworms, and other insects that may damage produce. These injuries are attractive to egg-laying flies.

Bury cull fruits or treat cull produce with 5 percent aldrin or dieldrin, or 10 percent malathion, each in granular form applied by hand. If dust is used, apply with dusting equipment. This is to eliminate *Drosophila* breeding near tomato fields.

Aphid

Description—Adults and young are tiny, green to black, and have soft bodies. They cluster on the underside of leaves or on stems.

Damage—If aphids are present in large numbers, leaves become curled and distorted and the plant becomes stunted.

Control—Aphids seldom become numerous enough to warrant insecticide applications on tomatoes. If they become numerous in home gardens, dust with freshly prepared 4 percent nicotine dust, or spray, using one

tablespoon of nicotine sulfate (40 percent) and two level tablespoons of soap flakes dissolved in each gallon of water. For commercial field control, apply 1 percent parathion dust, or spray with 1 pound of 25 percent wettable parathion powder dissolved in 100 gallons of water. Repeat treatment if necessary. Follow safety precautions printed on the manufacturer's label whenever parathion is used.

Precautions: Most insecticides are poisonous. Store them where children, pets, and livestock cannot reach them. Handle them with care. Read the labels, follow all directions, and heed all precautions. Parathion is extremely poisonous and should be applied only by a trained operator who will enforce the precautions prescribed by the manufacturers and assume full responsibility for safety. Do not apply parathion to tomatoes within 15 days before harvest. Do not apply DDT, TDE or toxaphene to tomatoes within 5 days before a harvest.

The authors: George F. Knowlton is extension entomologist. Howard E. Dorst is entomologist, U. S. Department of Agriculture, Agricultural Research Service, Entomology Research Branch.

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Cattle grub CONTROL

George F. Knowlton
Don W. Thomas

UTAH STATE AGRICULTURAL COLLEGE
DIVISION OF AGRICULTURAL SCIENCES
EXTENSION SERVICE Leaflet 15

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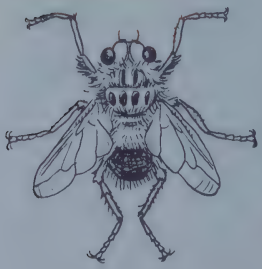
CATTLE GRUB

Cattle grubs are the maggots of the heel flies and bomb flies which annoy cattle in spring and early summer. Cattle grubs cause an annual loss estimated at $200,000,000 in the United States. Utah livestock owners experience their full share of this loss. Grub attacks commonly cause skin irritation, nervousness, waste, poor finish, subnormal gain in weight, sore and lumpy backs, and lowered milk production.

Life history



The adult heel flies and bomb flies emerge from matured grubs (puparia) during spring and early summer. These flies do not actually sting or bite, however they do terrorize the cattle. The female flies cement their eggs to the hairs on the legs and lower body parts of cattle.

Small maggots hatch in three or four days. Each newly hatched maggot crawls to the base of the hair, then burrows inward through the skin. This causes inflammation about each area of penetration.

During the several months spent inside the infested animals, the maggots crawl up through the leg muscles, through the abdominal and chest cavities, eventually reaching the esophagus. During winter and early spring, they move to the back of the animal. Each grub settles in the back and forms a cyst; it also cuts a breathing and emergence hole through the hide.

After a month or two in the cow's back, the full-grown grub squirms through the breathing hole, falls to the ground, and soon changes to a pupa. A fast-flying adult bomb fly or a heel fly emerges a few weeks later. A few to several hundred grubs may mature in the back of a single animal. Calves are usually more heavily infested with cattle grubs than older animals.

CONTROL

Rotenone-bearing cube or derris powder is recommended for cattle grub control. Apply it as a spray under strong pressure, or as a very fine dust. Treatment should begin from 30 to 45 days after grubs first appear in the backs. Repeat at 30- to 40-day intervals as long as grubs continue to appear.

Spray — Large herds of cattle ordinarily should be sprayed. This is the most rapid control method. Use from 7.5 to 10 pounds of finely ground (325 mesh) derris or cube powder containing 5 percent rotenone in each 100 gallons of spray. Sprayers should deliver a minimum nozzle pressure of 200 pounds per square inch with 400 pounds or more preferred. Drive nozzles, either fan or cone-shaped, may be used. When cone-producing nozzles are used, remove the whirl plates. Disc opening should be 4/64 in. on multiple nozzle brooms, and 5/64 in. on guns equipped with only one or two nozzles. Hold nozzles within 12 inches of the

animal's back. Use one gallon of spray per animal. High pressure sprayers drive the chemical beneath the hair and scabs and into the cysts, killing the grubs.

Dust — A dust is preferred by many dairymen and by owners of small herds. Dusts are good to use in cold weather or to treat infested animals at any convenient time. The dust usually can be purchased ready mixed. It should consist of one part of 5 percent rotenone-bearing ground root to each two parts of pyrophyllite or tripoli earth. At least three ounces of dust should be applied to the animal's back. Use a shaker with coarse openings. Thoroughly rub the powder into hair and cyst openings using a rotary motion of the fingertips.

For animals going on the range before full treatment can be applied, much benefit can be expected from two properly timed and well applied control treatments 35 to 40 days apart.

AREA CONTROL

Well organized cattle grub control programs result in greatest benefits. Where possible, treat all cattle in a valley, grazing area, or county; treat regularly and effectively. Area control cuts down the amount of infestation. It also reduces spring and summer annoyance by the troublesome heel flies.

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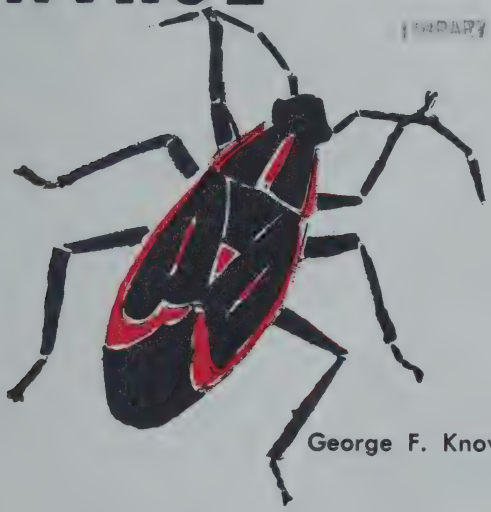

George F. Knowlton

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BOXELDER BUG

The boxelder bug is a red and black insect which clusters around boxelder trees during summer. The nymphs, or young, are of a more brilliant red than the adults. The mature nymphs and the winged adults are about one-half inch long and about one third as broad. They all have piercing, sucking type mouthparts. In summer the bugs normally feed on the underside of the leaves of boxelder trees.

The female bugs lay tiny red eggs in spring. After hatching, the nymphs pass through five distinct growth stages and become winged adults from mid-summer to late fall. With the arrival of cold weather the winged forms seek shelter in cracks around doors, windows, and porches. Eventually, many get into homes, schoolrooms, and offices where their presence is definitely undesirable.

Adult boxelder bug

Egg—much enlarged

CONTROL

Remove all unwanted boxelder trees about the home and town, especially those which produce seeds (pistilate trees). This will lessen the boxelder bug population and annoyance.

We can control the boxelder bug with insecticides. The following sprays, applied liberally and repeated as necessary, have proved effective.

Chlordane

In summer use at the rate of three pounds of chlordane 50 percent wettable powder in each 100 gallons of water. Apply liberally to the boxelder tree trunks, and to concentrations of bright red boxelder bug nymphs wherever they occur. This also aids in control of earwigs.

In fall mix one pint of chlordane 75 percent emulsifiable concentrate (or one quart of 40 percent concentrate) in each 25 gallons of water. Apply this liberally to adult and nymphal boxelder bugs whenever they congregate outside of buildings.

In winter spray the congregated adult boxelder bugs when they emerge from cracks about windows and doors of occupied buildings. Use one-half pint of chlordane 75 percent emulsifiable concentrate in two gallons of water. Also spray or paint liberally all outdoor cracks and surfaces about doors and windows where boxelder bugs hide.

Other insecticides

Heptachlor and dieldrin sprays, used out-of-doors, have been effective in any season. Apply the 25 percent emulsifiable concentrate of either insecticide at the rate of three tablespoons in each gallon of water. If the 25 percent wettable powder is used, apply it at the rate of four rounded tablespoons per gallon. Also treat cracks around doors and windows.

Apply malathion 57 percent emulsifiable concentrate at the rate of one ounce in each gallon of spray when both boxelder bugs and clover mites are numerous. Apply this to grouped insects, to the lower walls, and spray it for 15 to 20 feet out over adjacent lawn.

So far as is possible, boxelder bugs should be eliminated out-of-doors. Adult boxelder bugs are difficult to kill. They are not economically controlled indoors by means of aerosol insecticides. For heavy indoor infestations, use your vacuum cleaner.

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Tomato Russet Mite Control

Howard E. Dorst
George F. Knowlton

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Leaflet 33

Extension Service
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Tomato Russet Mite Control

H. E. Dorst and G. F. Knowlton

THE tomato russet mite damages all the green parts of tomato plants. It also feeds and reproduces on a number of other plants including potatoes and petunias.

Russet mites are so small that we cannot see them with the naked eye. We need at least a 15-power magnifying glass to recognize and observe them as they feed. Under magnification these mites appear pear-shaped and are tannish-white in color. Adults move slowly on plant surfaces. They feed by sucking out the sap from the cells.

Infestations usually start near the surface of the ground. Mites move up the stems and continue to feed on the plant parts, causing the plant to become russet colored. The center leaves dry and drop. This leaves the fruit exposed and sun scald is common. Damage is seldom noticed until late July or early August.

Adult female

The russet mite has a short life cycle. It passes through egg, nymph, and adult stages. The young whitish nymphs hatch from microscopic eggs which have distinct

caps. Adult mites are usually colorless, but are sometimes whitish tan or light yellow-orange. The mites move slowly over the surface of the plant, but the legs appear to be in constant motion.

The mite breeds and increases rapidly in warm weather. But it does not survive the winter in Utah fields, although it is possible for it to live in greenhouses or on plants in heated rooms. Entomologists believe that it is brought into Utah annually on plants such as tomato transplants, from other localities.

Control: To prevent the mite from being brought into the state, tomato growers and others buying seedling plants should buy only seedlings that have been dusted with 15 to 20 pounds of sulfur per acre within 7 days of the time they were packed for shipment. Plants should be so certified.

If growers suspect that the mite is present among their tomato plants, they should dust the plants thoroughly with 20 to 30 pounds of sulfur per acre. It is sometimes necessary to repeat this treatment. When wettable sulfur is used as a spray, 10 pounds an acre is recommended.

A 1-percent parathion dust at 25 pounds per acre will also give good control, but it must be applied at least 10 days before harvest or the tomato fruits will not be safe for human consumption.

If, in addition to the russet mite, tomatoes are also infested with tomato fruitworm, 10 percent DDT dust

should be added to a 50 percent sulfur dust and this applied at the rate of 30 pounds an acre.

Caution: Insecticides are poisonous. Handle them with care. Follow the directions and heed precautions on the container label.

Parathion is extremely poisonous. It should be applied only by a person thoroughly familiar with its hazards and who will comply with all the precautions on the label.

Do not apply DDT to tomatoes within 5 days before harvest.

Authors: Howard E. Dorst, entomologist, Entomology Research Division, U.S.D.A.; George F. Knowlton, extension entomologist, Utah State University, Logan, Utah.

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Control Spider Mites

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Donald W. Davis
George F. Knowlton

AUG 29 1958

UTAH STATE UNIVERSITY • LOGAN
EXTENSION LEAFLET 34

SPIDER mites, sometimes misnamed red spiders, damage many crops, especially orchard fruits. Unless the orchardist is on the alert, he may fail to recognize the presence of mites in time to prevent serious losses.

There are two basic types of spider mites. One type, which includes the brown mite and the European red mite, spends the winter as eggs on twigs and limbs. The second type, the two-spotted mite and its relatives, spends the winter as an adult in a protected spot, often in the soil near the host plant. This second type also damages berry plants, many ornamentals, and vegetable crops.

Control

There are three ways to control spider mites:

1. Apply a spray at bud-swelling time to kill the winter eggs before they hatch in the spring. A thorough drenching spray is needed to cover the areas where the eggs are located. All the following sprays are safe for the operator.

    - Dormant oil used at about 3 to 4 gallons per 100 gallons of spray. This spray controls mite eggs, scales, and certain other insects, but sometimes causes twig and bud injury.

    - Lime sulfur at 8 to 10 gallons of spray. This spray controls mite eggs, San Jose scale, and peach twig borer, however it is unpleasant to handle and is corrosive to equipment.

    - Lime sulfur 3 gallons plus dormant oil 1 gallon per 100 gallons of spray has

the advantages of both oil and lime sulfur.

- Genite 923, Mitox, and ovex (Ovotran) kill mite eggs and are easy to handle and adaptable to many situations. Read the label carefully as there is danger of spray injury if used on certain crops and foilage.

2. Apply residual sprays early enough to prevent mite buildup, and crop injury. Most of these sprays do not give quick kills. Exceptions are demeton, Trithion, Chlorobenzilate, and Guthion. Miticides most commonly used in Utah and directions for their use are given in the table.

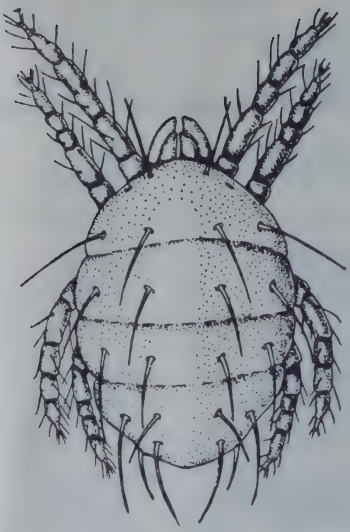
3. Apply knock down sprays to get quick control. Most of these are organic phosphates. They range from materials relatively safe to handle, such as malathion, to highly poisonous TEPP and parathion. Their action is both by fumigation and contact, but their effectiveness is for only a short time. A number of mite species have acquired resistance to these sprays. These sprays have four uses:

   - To step up the killing action of slower residual miticides.

   - To get immediate relief from large buildups of mites.

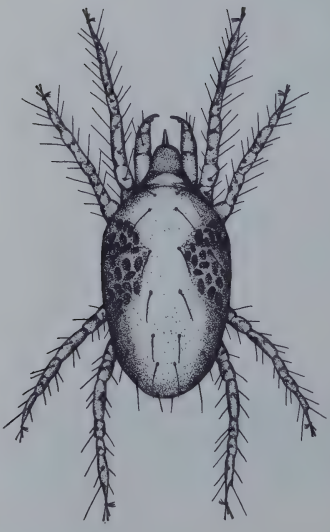
   - To use near harvest time when materials leaving residues cannot be used.

   - To use when nearly all mites are active, such as early in the year when mite eggs have hatched and new eggs are not laid.



European Red Mite

Brown or Clover Mite



Two-spotted Spider Mite

Miticides and direc

Miticide	Kinds of mites controlled	Toxicity to operator
Aramite	Two-spotted European red	Little danger
Chlorobenzilate	Two-spotted and related species	Little danger
Demeton (Systox)	General (some resistance in McDaniel mite)	Highly poisonous
Guthion	General (some resistance)	Poisonous
Kelthane	General	Little danger
Sulphenone	Two-spotted mite and related species	Little danger
Trithion	General (some resistance)	Somewhat poisonous

Dr. Donald W. Davis is associate professor of entomology. Dr. George F. Knowlton is extension entomologist.

tions for their use

Rate per 100 gal.	Length of control effectiveness	Plant injury
1½-2 pounds	About 3 weeks	Some varieties of pears
1½ pounds	About 3 weeks	Stone fruits; some apple varieties
1-1¼ pints	About 6 weeks	Not recommended on most stone fruits
3 pounds	About 6 weeks	Generally safe
1½ pounds	About 6 weeks	Generally safe
3 pounds	About 3 weeks	Generally safe
1½-2 pounds	Variable	Not fully known

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Control Poultry Pests

Don W. Thomas
George F. Knowlton
Leslie Darrington

UTAH STATE UNIVERSITY • LOGAN
EXTENSION LEAFLET 36

AUG 29 1958

LICE, mites, and flies often cause a drop in egg production in poultry of from 10 to 20 percent. Infested birds may lose weight.

Well planned and constructed houses and yards make control of the pests much easier. If poultry houses have few cracks and loose boards, pest control is simplified.

Several of the newer insecticides are effective against poultry parasites and are relatively safe to use. One of these is malathion; lindane and DDT also have certain uses, as do nicotine sulfate, carbolineum, and sodium fluoride.

Residual type sprays

The house sprays listed in the guide are residual type sprays. Except where otherwise indicated, apply in coarse droplet form on the walls, roosts, nests, and floors in a sufficient quantity to wet the surface thoroughly without appreciable runoff. For best results, use a power sprayer. A hand sprayer may be used for small units. Remove or protect feed, feeders, and water from contamination during control operations.

Direct spray applied to birds

Sprays are best applied at night when the birds are roosting; however, birds in relatively small cages containing not more than 50 fowls each may be sprayed when convenient. Each bird must be sprayed thoroughly.

Dust application

Hand application of dusts to poultry is a slow procedure. It is practical only for small flocks and where circumstances do not warrant the use of sprays, such as with caged birds or in cold weather.

Sanitation

Sanitation is basic to effective fly control. Good management practices should be aimed at the prevention of fly breeding. Use residual sprays to supplement sanitary measures.

Where possible, remove poultry manure every four or five days to reduce fly breeding. Drain

moisture away from manure. Few flies breed in dry manure. Good ventilation and drainage will speed manure drying in the poultry house. Manure may be stored in fly-proof bins or pits, or spread thinly over fields at frequent intervals to reduce fly breeding.

Suggested formula for mixing

$$\frac{\text{Quantity wanted} \times \text{percent wanted}}{\text{Percent you have}}$$

Example: Desired 100 gallons of 1 percent malathion to be used as a house spray from a 57 percent concentrate.

$$\frac{\text{Quantity wanted (100 gal.)} \times \text{percent want}}{\text{Percent you have (57\%)}}$$

Precaution

Read carefully the labels on all insecticide cont

FLY CONTROL—

Type of treatment	Insecticide and formulation	
Residual sprays	Malathion 55-57% emulsifiable concentrate	
	Diazinon 25% emulsifiable concentrate	
	Dieldrin 50% wettable powder	
Dry baits	Dipterex commercial bait	
	Malathion 25% Wettable powder	
	Diazinon 25% wettable powder	
Liquid baits	Dipterex	
	Malathion 55-57% emulsifiable concentrate	

Baffles used beneath open-floor cages will help to break up and dry the droppings more rapidly during warm, dry weather.

Fly breeding is seldom a serious problem when birds are maintained in a deep litter.

any quantity of insecticides

= Amount of concentrate to use

d (1%) 100 = 1.75 gal. of malathion concentrate

iners before using the contents.

SPRAYS AND BAITS

Amounts	Remarks
3 pints + 2½ cups sugar + water to make 10 gallons	Spray poultry houses, inside and outside.
1½ pints + 2½ cups sugar + water to make 5 gallons	Spray on outside only of poultry houses and nearby fly-resting places.
2 ounces + 8 ounces sugar in 3 gallons water	Apply to walls of houses. Do not spray litter. Spray fly-resting areas about farm buildings.
4 ounces per 1000 square feet	Sprinkle over floor and other areas where flies congregate at 4 ounces daily if necessary. Do not contaminate feed or water, or scatter where fowls may pick up the bait. Commercial ready-mixed dry baits are effective.
6 tablespoons mixed in 1 pound of sugar	
3 tablespoons mixed in 1 pound of sugar	
½ cup + 3 cups sugar in 1 gallon water	Apply 1 gallon of mix to each 500 square feet of area treated. Sprinkle or spray on surfaces frequented by flies. Do not contaminate feed or water, or apply where birds may contact the bait. (This may be ineffective if used on absorbent surfaces.)
3 teaspoons + 3 cups sugar in 1 gallon water	

Pest	Insecticide and formulation
Common poultry mite	Malathion 55-57% emulsifiable concentrate
	Malathion 4% dust
Northern fowl mite	Malathion 55-57% emulsifiable concentrate
	Malathion 4% dust
Lice	Malathion 55-57% emulsifiable concentrate
	Nicotine sulfate 40% solution
	Sodium fluoride 95-98% dust
Sticktight flea and western chicken flea	Nicotine sulfate 40% † lindane 20% emulsifiable concentrate
Bedbug	DDT 25% emulsifiable
Scaly leg mite	Lindane 20% emulsion or crude petroleum oil

MARY CHART

Amount	Remarks
¾ pint in 5 gallons water	Spray house thoroughly. (Include litter, nests, roosts, and spray directly on birds.)
1 pound for each 50 square feet of litter	Apply to litter, roosts and nests with metal hand duster. (Dust may be used as a supplement to or in place of spray on litter, nests and roosts.)
6 ounces † 2 ounces dry commercial detergent in 5 gal. water	Spray this mixture on birds at the rate of 1 gallon to each 100 birds.
1 to 2 ounces per 30 birds 1 pound dust per 50 square feet of litter	Apply 2 strokes per bird with hand puff-duster, or 2 shakes with hand applicator. 4% dusting of litter, roosts and nest boxes improves control.
¾ pint in 5 gallons water	Spray house and birds thoroughly
6.4 ounces per gallon water	Paint or spray roosts. Use 1 to 2 pints per 100 lineal feet of roosts.
1 pint, undiluted	Paint roost, using 1 pint to each 150 feet of roost.
Several pinches	Ruffle into feathers under each wing, both sides of breast, at vent, back and neck.
2 quarts n.s. † ½ pint lindane † water to make 5 gallons	Apply as a house and floor spray.
3 quarts in 100 gallons of water	Spray house thoroughly, with emphasis on cracks and ends of roosts.
1/3 teaspoon in one gallon of water	Dip shanks of birds in either solution for control.

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TTLE LICE

Let's Control Them

George F. Knowlton

Don W. Thomas

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EXTENSION LEAFLET 37

AUG 20 1959

CATTLE LICE
Let's Control Them

George F. Knowlton
Extension Entomologist

Don W. Thomas
Extension Veterinarian

BLOOD sucking lice cause loss of blood and constant irritation, lower the vitality, slow down growth rate, and reduce milk production in cattle in Utah. A severe infestation of lice causes anemia. All this results in a large financial loss to livestock owners.

These lice are small wingless insects with flattened bodies. The eyes are tiny or lacking. They suck blood through their extensible mouth tube which contains two knife-like piercing organs. The eggs of lice are often called "nits." They are glued to the body hairs of the host animals. When first hatched, young lice resemble the adults but are much smaller.

Control:

The usual time to control lice is in fall or early winter. Three methods are used: dipping, spraying, and dusting. When the spray is used, many owners will find it profitable to spray in the fall and again in the spring. Dusting for lice is practical only when the number of animals to be treated is small, or when weather is too cold to spray or dip.

Beef: Several insecticides are effective for control of lice on beef animals and dry stock (table 1). When toxaphene, methoxychlor, malathion, or lindane are used at the recommended strength, the residue of the spray generally remains effective long enough to kill the young lice

as they hatch from the eggs. When rotenone is used, no such effective residue remains on the hair of the animals. Therefore, a second dipping or application of spray should be made 14 to 16 days after the first treatment. Timing here is important to prevent any lice from maturing and laying eggs before the second control treatment is applied.

Milk cows: It is essential that no poisonous material be applied to milk cows which could be taken into the body, then later appear in the milk supply. Only rotenone-bearing materials and pyrethrins plus synergist, are suggested.

Cattle lice have commonly been controlled with wettable powders. When emulsions are used instead, an equivalent strength of the active insecticide ingredient is required.

Rubbing devices:

Cattle annoyed by lice rub against objects. An excellent rubbing device can be made with several strands of barbed wire 12 to 20 feet long. Suspend the wires between two sturdy posts. The tallest post should be about 5 feet high and the lowest 18 inches. Wrap the wires with 10 to 15 burlap sacks, tied at 6 inch intervals, using a strong twine. Treat the rolled sacks with one of the mixtures shown in table 2. Apply about one gallon of the mixture to each 15 to 20 linear feet. Pour this material evenly on the sacks. Re-treat the rubbing device as necessary, to keep it effective.

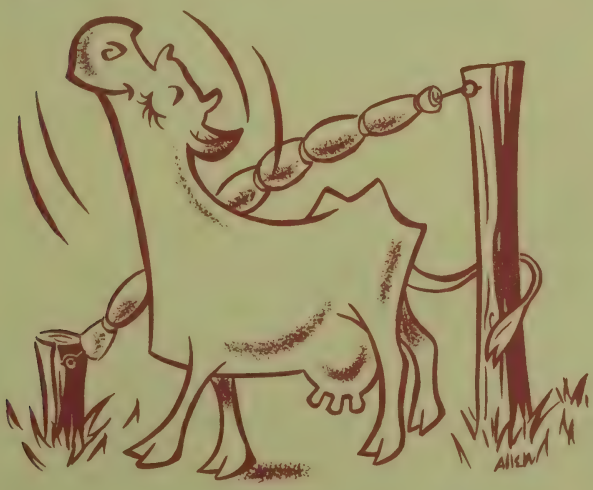

Table 1. Insecticide formulas for dipping or spraying cattle:

Insecticide	Formulation	Amount in 100 gallons
Rotenone	5 percent finely ground root	1½ to 2 pounds
Rotenone plus sulfur	5 percent finely ground root 325 mesh wettable	1 pound 10 pounds
Toxaphene or methoxychlor or malathion	50 percent wettable or if 25 percent wettable	8 pounds 16 pounds
Lindane	25 percent wettable	1 pound

The Long-nosed—Cattle Louse

The Little Blue Cattle Louse

The Short-nosed Cattle Louse

The Little Red Cattle Louse

Table 2. Insecticide formulas to be used on rubbing devices:

Insecticide	Formulation	Amount in 1 gallon of fuel oil
Methoxychlor	25 percent emulsifiable concentrate	1 quart
Toxaphene	60 percent emulsifiable concentrate	1 pint
Malathion	50 percent emulsifiable concentrate	1 pint
Lindane	20 percent emulsifiable concentrate	1 pint

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CONTROL THE ELM LEAF BEETLE

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COOPERATIVE EXTENSION SERVICE
LEAFLET 43 • APRIL 1959

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The Elm Leaf B

George F. Knowlton, extension entomol

The elm leaf beetle skeletonizes elm leaves when trees are found. Damage has been particularly s northern and central Utah.

What does the beetle look like: The adu is about ¼ inch long, yellowish to olive-green, with to dusky stripe along the margin-area of each wing co antennae are long and yellow. Females lay orange-yel in groups of 5 to 25, attached at one end to the unde the leaves. The young grubs, or larvae, are nearly bl full-grown larvae reach a length of nearly ½ inch, yellow in color with two black stripes along the side back. The head, legs, and tubercles are black. Th orange-yellow pupa is about ¼ inch-long, with a fe bristles. The species usually has but one generation central Utah.

Damage: Elm trees may be severely stripped leaf tissue during seasons when the leaf beetle is a Trees usually recover from one season of severe lea They may become severely damaged, and some several consecutive years of extensive elm leaf destru

A well timed application of DDT, lead arsena similiar orchard spray usually results in effective c the elm leaf beetle. Spray is best applied to the undersi leaves in spring when the leaves are about three-fou Community control effort should be encouraged, the beetle tends to reinfest sprayed trees from nea sprayed elms. If trees are not sprayed until the larva and are hunting places to pupate, the trunk and soil a tree should also be sprayed.

DDT—Malathion: Apply 1 quart of 25 percen fiable concentrate DDT plus 1½ pints of malathion 5 in each 100 gallons of spray. Use 2 teaspoonfuls D 1½ teaspoons Malathion per gallon for small Thoroughly applied this should be effective in killi and adult elm leaf beetles and preventing mite buildup DDT application. Do NOT substitute parathion for

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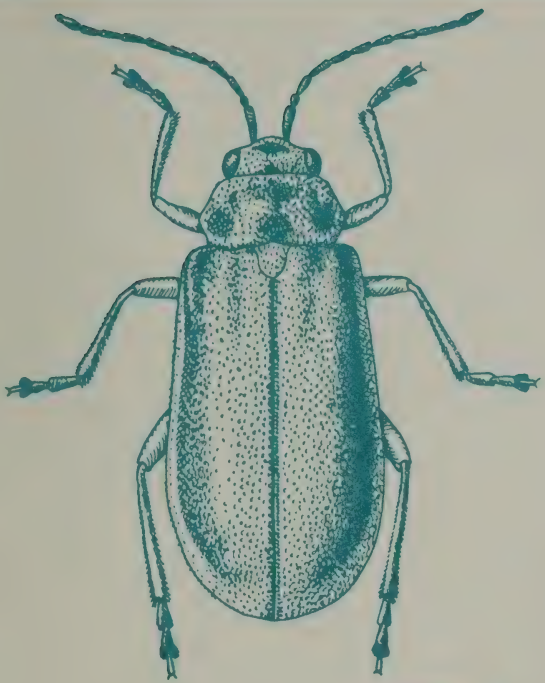

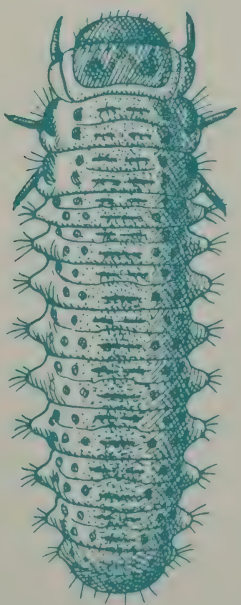

Elm leaf beetle adult, eggs and larva

for spraying trees about homes, parks, or playgrounds. Malathion is added to control mites; it also aids in aphid and scale control. If preferred, some other miticide may be substituted for malathion for use with DDT.

Lead arsenate: Four pounds of powdered lead arsenate plus 16 ounces of summer-type oil in 100 gallons of water will give effective control. Use 2 tablespoonfuls lead arsenate plus 1 teaspoonful summer-oil for each gallon in small amounts. This treatment is seldom followed by mite outbreaks.

Time to spray: Early morning spraying is suggested, especially along highways, near parks, and about homes. Put the spray on before there is much automobile traffic. Do not spray when children are playing under the trees.

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Wireworms control them

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Wireworms damage underground parts of peas, beans, corn, potatoes, sugar beets, onions, lettuce, melons, squash, wheat, barley, and other cultivated crops and garden flowers in Utah. The tough-skinned, shiny, yellow to orange-colored larvae usually live in the soil for two to three years. When larval growth is completed they pupate. Within a few weeks they become adult click beetles.

Excellent chemical control has been developed during recent years.

Residual chemicals: Heptachlor, dieldrin, or aldrin at three pounds actual chemical per acre, or DDT or chloradane applied at rates of ten pounds per acre will give effective wireworm control for several years. The chemical should first be applied uniformly to the surface of the soil as a wettable powder, dust, or emulsifiable concentrate in fall or spring. Disk the insecticide in, plow to a depth of 6 to 9 inches, then harrow. Use of these residual chemicals gives most effective control beginning the second season after treatment. Older and more resistant wireworms may not be killed until a few months after the insecticide has been mixed with the soil.

Row treatments: As row treatments, apply 1 pound of actual aldrin, dieldrin, or heptachlor per acre in the furrows, at the time seeds are planted.

Seed treatments: Damage from wireworms can often be reduced by seed treatments. Larger commercial seed houses ship many seeds already treated for planting. For home control of both wireworms and fungus, apply 1 ounce (or as otherwise recommended) actual aldrin, heptachlor, or lindane plus an equal amount of thiram (Arasan) or Captan per 100 pounds of larger seeds.

Wireworms control them

George F. Knowlton, extension entomologist

Transplant applications: ¼ pound of aldrin or heptachlor has sometimes been mixed with each 100 gallons of water used in transplanting young plants. Wettable powder or emulsifiable concentrate is suggested. If too much chemical is used, injury occurs.

NOTE: Use of BHC and chlordane is NOT recommended in home garden soils, nor in land which may be used within a few years for raising canning or root crops. An undesirable off flavor taste has been produced in a number of crops grown on soils treated with benzene hexachloride, and in fewer instances where chlordane has been applied.

Fumigation: For immediate control, ethylene dibromide is an effective soil fumigant. Gas from this liquid permeates soils, killing the wireworms. The 40 percent liquid solution is usually applied in the soil at the time of plowing at the rate of 10 gallons per acre. The 85 percent solution is used at 3 gallons per acre in ordinary soils. Some increase in dosage may be desirable where soils are heavy. Fumigant may soon be lost in coarse sandy or gravelly soils. Ethylene dibromide is poisonous, so open and use it out of doors only. Carefully follow all

safety precautions as given on the printed label. Plant injury will occur if this chemical is applied at these dosages to growing crops. Plant 7 to 10 days after fumigation. This fumigant kills wireworms promptly but does not prevent future wireworm infestations.

Life history: Click beetles are the adult stage of wireworms. Each mature female may lay from 50 to 300 tiny, pearly-white eggs in the soil. Eggs hatch into small white larvae. These become the tough, shiny, jointed wireworms, yellow to yellow-orange in color. The last segment of the body is usually forked or pronged behind. Under favorable conditions, most injurious species mature in three years. Maturing wireworms transform to delicate white pupae, later becoming adult click beetles. Adult beetles emerge and mate from April to June.

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Mexican Bean Beetle

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control it

UTAH STATE UNIVERSITY • LOGAN
COOPERATIVE EXTENSION SERVICE
LEAFLET 45 • APRIL 1959

The Mexican bean beetle causes serious injury to canning and home garden beans in infested areas of Utah. The beetle has continued to spread to new localities in recent years.

Larvae and adult beetles feed on the underside of bean leaves. This causes a characteristic ragged, network-like feeding pattern. One soon learns to associate this type of foliage injury with the Mexican bean beetle. Pods and stems may also be damaged during severe outbreaks. Injury is most severe during July and August.

Appearance: Adult bean bettles are copper colored and round backed. They are about ¼ inch long and 1/5 of an inch wide. They have sixteen black spots on their backs, arranged in three rows. The female beetles lay orange-yellow eggs in groups. The young, or larvae, appear fuzzy, are lemon-yellow, and covered by rows of protruding branched spines. The larvae vary in size from tiny when hatched to 1/3 of an inch long just before pupation.

CONTROL

Retenone spray: Spray infested home garden and field beans using 2½ pounds of finely ground derris or cube powder (of 5 percent rotenone strength) in each 100 gallons of water (2½ level tablespoons per gallon). First wet the powder with a little water, then wash this mixture through a fine screen into the sprayer tank. For hand sprayers in the home garden, use 8 level tablespoons of this strength rotenone powder (½ cupful) in each 3 gallons of water.

the Mexican B

George F. Knowlton, extension entomologis

Eggs, larvae, pupa and adult of the Mexican bean beetle.

Apply th
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Rotenone Dust: Use a dust w
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ean Beetle

control it

spray chiefly to the underside of the leaves, the part by this beetle. Spray all bean plants thoroughly. Only above gives little control benefit. Keep the spray ed so the powder will not settle to the bottom of the

nercial fields use larger spray outfits with a nozzle 0 to 250 pounds. If possible, direct the spray upward of the row. Repeat the control treatment if necessary.

ich contains 0.75 to 1 percent actual rotenone. To ob- ol blow the dust upward so as to strike the lower side Twenty-five to thirty pounds of this dust mixture per d for each application. Hand dusters can be used in but power dusters are needed for commercial fields.

fective as a spray when two pints of 50 to 57 percent ncentrate per 100 gallons of mixed spray (2 tea- llon) is sprayed against the underside of leaves. A 4 t 30 pounds per acre is also effective. Do not apply in one day of harvest.

lds of beans grown for dry beans may be sprayed of 25 percent wettable parathion in each 100 gallons of a 2 percent parathion dust at 25 pounds per acre ve. CAUTION: Parathion is highly poisonous. It plied only by a trained operator who will use the ions prescribed by the manufacturer on the printed l. Do not apply parathion about homes, nor on crops s of harvest.

Infested fields of snap beans should be plowed as soon as picking is completed.

Life History

Adult Mexican bean beetles survive through the winter. In spring they leave their winter quarters and feed on bean foliage for a week or two. Females then begin laying yellow-orange eggs in groups of 40 to 60. These are deposited on the lower surface of bean leaves. The tiny young grow into orange-colored larvae which become longer than the adults. As it grows the larva molts or sheds its skin a few times. Each larva has six rows of soft black-tipped spines. When full grown the lemon-colored larva attaches itself to the plant, usually beneath or inside a curled leaf. It first becomes shorter and wider, then changes into the pupal stage. The light yellow adult beetle emerges from the pupa; its shell hardens and darkens and the 16 black spots appear. Development from egg to adult requires about a month. One or two generations are produced each year.

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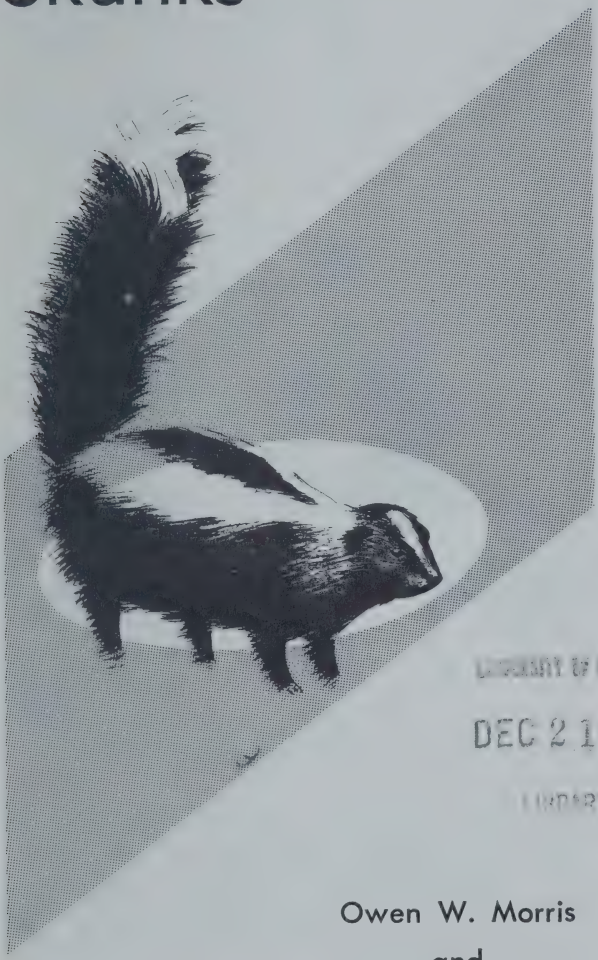
Controlling Skunks



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Owen W. Morris
and
George F. Knowlton

UTAH STATE UNIVERSITY

Extension Service Leaflet 46

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JUN 3 1959

SKUNKS are usually beneficial to man since they eat many insects and mice. In cooler parts of their range they are valuable as producers of fur.

Occasionally, skunks kill poultry and destroy eggs. They are not good climbers, and their depredations are limited to poultry roosting on or near the ground and to eggs in nests near the ground. A skunk may take a single bird at a time, but once the habit is formed, it repeatedly visits the poultry yard. Such an individual should be eliminated. In some instances, however, farmers will find that the real culprits are rats, weasels, or even mink, all of which are adept climbers and kill far more ruthlessly.

The skunks' fondness for insects sometimes results in depredations on beehives. Skunks are the principal predators of ground-nesting alkali bees in some parts of Utah. They sometimes dig holes in lawns, golf courses, and meadows in search of beetle larvae and other grubs. Inexperienced dogs can seldom resist the temptation to investigate the trail of a skunk, but an encounter usually ends distastefully for the dog. At times skunks also transmit rabies to man and domestic animals.

Vinegar or household chlorine bleach, in weak solution, or tomato juice is suggested to remove the odor from dogs or clothing.

Skunks come out at night to seek their food —grubs, insects, small rodents, carrion, soft fruits, berries, and unripened corn. They may at times take birds' eggs and fledglings from nests on or near the ground. Despite their short legs, skunks may travel considerable distances in their nightly forays.

Generally, rather than dig a den, they choose a convenient hole and enlarge it. A cavity in a rock pile or space under the floor of a summer cottage, farmhouse, or outbuilding is often used. The same den may be occupied by a number of skunks, and the penetrating, nauseous odor from such a place is highly objectionable.

Preventive Control

Rather than destroy skunks needlessly, it is better to keep them from establishing themselves where they will become a nuisance. If they are numerous, seal all openings in the foundations of garages, porches, and outbuildings through which any small animal might enter. If they are already beneath buildings, seal off all openings except a single exit. Sprinkle a flour patch at the entrance and examine the area after dark. If trail signs indicate the animal has left the den site, the remaining opening should be closed off immediately.

Skunks living under buildings can often be driven away temporarily by repellents. Naphthalene or paradichlorobenzene are sometimes satisfactory for this purpose. About a pound of flakes or moth balls should be placed in the den and scattered about it. After skunks have left, all openings in or under the foundation should be closed promptly with cement, sheet metal, or wire netting. Skunks can easily be excluded from poultry houses by closing all doors and other openings each night.

Reductional Control

Skunks can be caught with no. 1 or no. 1½, no. 2, or no. 3 steel traps set at the entrances to their dens. They are frequently taken in unbaited traps, but with better success if the head of a fowl or a dead mouse is used as a bait or if a fetid scent is used to attract them. Traps should be concealed by removing a sufficient

amount of earth so that the top of the trap when set will be flush with the ground level. Cover jaws and pan of trap with a piece of light canvas or paper cut slightly larger than the outline of the trap jaws in a set position. Cover the trap not to exceed ¼ inch with fine dirt. The trap chain can be attached to a stake driven into the ground or fastened to a long slender pole. The latter method will enable the trapper to pick up the pole and remove the skunk a distance from dwellings where it can be shot or drowned. Skunks rarely emit their scent when their feet are off the ground. When a den is used by more than one animal, time may be saved by setting several traps near the entrance. Skunks may also be caught in any simple trail-set.

If other methods fail or the required equipment is not available, skunks can be controlled by the use of poison. Make a small hole in one end of an egg, about ¼ inch in diameter. Remove a small portion of the white of the egg. Place a small amount of strychnine (approximately ⅛ teaspoonful) through the opening. Stir the strychnine into the contents of the egg with a slender stick or piece of wire, and seal the hole in the end with a tissue paper patch. With a red crayon write the words, "Warning—Poison" on the egg shell. Food coloring may be added to the egg contents as a further safeguard.

If skunks refuse to eat eggs, fill a no. 4 gelatin capsule with strychnine. Flatten in the palm of one hand an amount of hamburger or ground fish large enough to make a round ball approximately ½ inch in diameter. Place the capsule in the center of the flattened meat or fish, fold the material over the capsule, and roll the bait into a round ball.

The judgment of the operator will determine the safest place to put the poisoned egg or bait to avoid the accidental poisoning of domestic pets. It may be placed under buildings and in other locations frequented by skunks or used by them as dens.

Skunks are not protected by law in Utah.

Owen W. Morris is district agent, U. S. Fish and Wildlife Service. George F. Knowlton is extension entomologist, Utah State University.

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Controlling Muskrats

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Owen W. Morris and
George F. Knowlton

UTAH STATE UNIVERSITY

Extension Service Leaflet 47

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ONLY when muskrats cause damage to dams, dikes, and canals or feed on agricultural crops do they need to be controlled. Most of the damage results from their den-building activities. Burrows begin below the water surface and penetrate the embankment on an upward slant. They hollow out a room above the water level to form a dry chamber. Damage occurs when a rise in water level forces muskrats to dig further and higher to construct a new dry chamber. In such cases they may tunnel completely through a dam or embankment.

Muskrats are probably the most important fur bearing animals in the United States. Several million are trapped annually and their fur is valued at many millions of dollars.

They belong to the rodent family and weigh about two pounds. Their hind feet are partially webbed for swimming; the long tail is laterally compressed and scaly; their fur is dense.

They make their homes by burrowing in banks or building "houses" of rushes and other water plants. The entrance to their homes is almost always under water, but the nest is above the water level.

Muskrats have from three to five litters each year, with an average of six to eight young to each litter. They are chiefly nocturnal and their principal food is stems, roots, bulbs, foliage of aquatic plants, and occasionally garden crops. They also feed on snails, mussels, crustaceans, insects, and fishes.

CONTROL

Trapping. Muskrats are easily trapped with an ordinary number 1 steel trap. Their presence is indicated by narrow channels or runs through the marsh between nesting sites and nearby feeding grounds, air bubbles under the ice, bank burrows, plant cuttings, tracks, plunge holes, muddy water, defecating posts, and houses and feeding huts.

Muskrat trails may be found along the banks of streams or canals and the practiced eye can often trace them into shallow water. Muskrat burrows and feeding spots can be located by carefully inspecting the bank just below the surface of the water. These are good locations for setting traps. Sink the trap in the mud or

sand where the water is 2 or 3 inches deep. Fasten the chain to a stick or slender pole imbedded firmly into the bank and extending horizontally toward the deep water. Or imbed the stick vertically in the mud out from the bank where the water is at least a foot or more deep. The pole on which the ring of the chain is to slide should have a fork on the outer end to prevent the ring from slipping off.

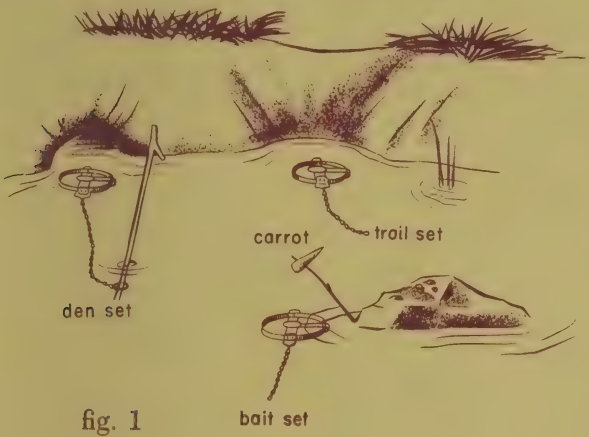

fig. 1

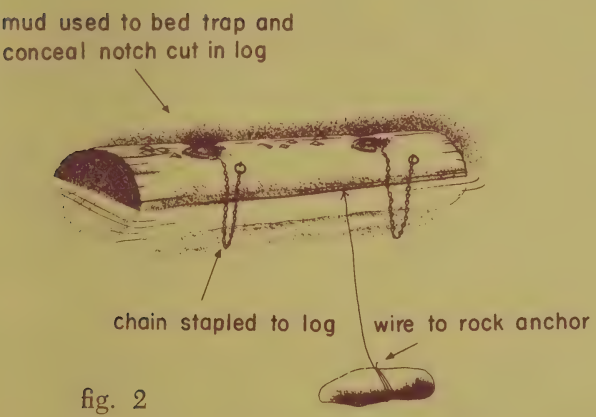

fig. 2

If bait is used, fasten it to a sharpened sloping stick (fig. 1) set in the mud so that the bait is about a foot above the pan of the trap. The animal, in reaching for the bait, sets its foot on the pan and is caught. It immediately plunges into deep water, sliding the chain along the pole as far as it will go, and soon drowns. Unless the animal drowns soon after it is caught, it is likely to twist its leg off and escape.

Traps may be set on floating logs (fig. 2), on planks extending at an angle from the bank

into the deeper water (fig. 3), and other projecting objects on which muskrat droppings are noted.

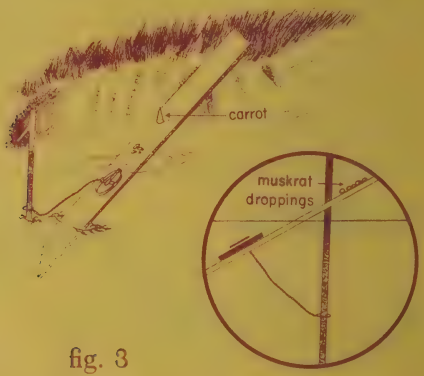

fig. 3

Traps should be set about 2 inches under the water level. Bait may or may not be used in this type of set. If a bait is used it may be attached by inserting it onto the end of a ten-penny finishing nail driven into the log or plank.

Carrots, parsnips, apples, or similar material may be used for bait. They should be cut into pieces approximately ½ to 2 inches long. If poison is used, bait materials should be scraped or peeled so that the surface will be moist enough for the poison to adhere to.

Two poison materials are recommended.

1/4 ounce zinc phosphide to 1 quart bait, or
1/16 ounce strychnine to 1 quart bait

Place the cut bait in a two-quart container. Dust the poison on the bait. Place the bait as soon as it is treated. Do not endanger the lives of children and pets by putting the bait where they can get it.

Contact your county agricultural agent, or the district agent of the U. S. Fish and Wildlife Service, 232 South West Temple, Room 103-C, Salt Lake City 1, Utah, for information on the source of poison materials and for further assistance in handling this problem.

Owen W. Morris is district agent, U. S. Fish and Wildlife Service. George F. Knowlton is extension entomologist, Utah State University.

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ntrol of the Harvester Ant

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Control of th

THE western harvester ant is a serious economic pest over vast areas of rangelands as well as on hundreds of farms and ranches in Utah and elsewhere in the West. Bare areas ranging from 3 to 35 feet in diameter, cleared of vegetation, stand out prominently in fields throughout the state. The ant's persistent collecting of seeds for nest storage as food reduces range vegetation which is a serious economic loss to livestock owners and farm operators. In addition to collecting weed seeds and seeds of range plants, the ants also collect large quantities of both planted and shattered alfalfa seed from seed fields. Wheat, barley, oats, and other planted seeds are taken from fields and gardens by the harvester ant. Lack of vegetation creates an erosion problem of considerable importance on watersheds. Considering the area infested by this ant, the yearly loss of forage and farm crops adds up to a staggering amount.

The western harvester ant, *Pogonomyrmex occidentalis* Cresson), is reddish, fairly large, and aggressive. Its sting is painful. Small children should not be left alone out of doors where the ants are present. Livestock are also annoyed by these pests.

This ant lives in subterranean nests several feet deep and capped with cone-shaped mounds with one or more openings. While entrances to

harvester ant

George F. Knowlton
Extension Entomologist

the nest are usually on the cone, they are sometimes 2 to 16 inches away from the mound. Each mound is made up of many tunnels and brood nests. Large collections of seeds and sometimes dead insects, pollen, and other materials are stored in the chambers.

CONTROL

Control ants during spring and summer while they are active. Treatments for use over large areas must be inexpensive in cost and labor as well as effective.

Heptachlor

1) I to 2 heaping tablespoonfuls, 25 percent wettable powder, applied over entrance openings and about ant mounds. Inspect the nests in two or three weeks and again the following spring. Re-treat all nests where activity is found.
2) 1 heaping tablespoonful of 25 percent wettable powder or emulsifiable concentrate in each quart of water. Pour into ant entrances and over the nest. Use 2 quarts of this mixture for large nests.

Baits

1) 2 ounces aldrin, ½ gallon fuel oil, 100 pounds steamed rolled wheat applied by aircraft. This treatment killed most ants in a heavily infested Tooele County area near Vernon.
2) ½ pound wettable heptachlor, enough liquid to insure uniform distribution of toxicant, 100 pounds of cracked wheat. Apply 5 grams about each colony in spring or summer when ants are active. This method has controlled ants in Colorado.

Inspect and repeat treatments if necessary. Less insecticide is generally needed for retreatment. If the colony is permitted to build back to normal strength, it becomes more difficult to destroy.

THE RED HARVESTER ANT

A second species, the red harvester ant, *Pogonomyrmex barbatus* (F. Smith), occurs at lower elevations in southern Utah, particularly in parts of Washington and Kane Counties. This larger, more aggressive ant is even more of a problem than the western harvester ant. Control methods are similar to those for the western harvester ant, but insecticides should be applied more liberally and over a much larger area. Retreat any living colonies later in the season, and if survival occurs, retreat before June of the following year.

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Control the Boxelder Bug

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George F. Knowlton

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THE boxelder bug is a household nuisance. It breeds on boxelder trees and spreads to the warm sides of buildings and works its way into openings. It often causes "catfacing" of fruits by feeding on them when they are young.

This red and black insect is about a half inch long and 2/16 inch wide when mature. The nymphs, or young, are of a more brilliant red than the adults. All have piercing, sucking mouth parts. They feed on the underside of leaves of boxelder trees where they lay their eggs in spring. After hatching, the nymphs pass through five distinct growth stages and become winged adults from midsummer to late fall. With the arrival of cold weather, they seek shelter in cracks around doors, windows, and porches. Eventually, many get into homes, schoolrooms, and offices.

CONTROL

Control bugs out-of-doors. Use of household sprays makes walls, curtains, and draperies oily. For heavy indoor infestation, use your vacuum cleaner.

Use the following outdoor sprays liberally and repeatedly. They aid in controlling earwigs, ants, flies, and other pests:

Dieldrin or heptachlor

1) 2½ quarts in each 100 gallons of spray for large area summer and fall cleanups using power equipment.

2) 3 tablespoons of emulsifiable concentrate of either insecticide in each gallon of water.

   Apply around cracks of doors and window frames during fall and winter.

Chlordane

1) 3 pounds 50 percent wettable powder in each 100 gallons of water.

   Apply liberally in summer to boxelder tree trunks, around bases of trees, and to concentrations of nymphs wherever they occur.

2) 1 pint 75 percent emulsifiable concentrate in each 25 gallons of water.

   Apply wherever bugs congregate in fall.

3) ½ pint 75 percent emulsifiable concentrate in each 2 gallons of water.

Spray bugs congregated on south walls of buildings when weather is warm. Also spray or paint all outdoor cracks and surfaces about doors and windows.

Malathion

1) 1 ounce 57 percent emulsifiable concentrate in each gallon of spray.

   Apply to congregated insects, to lower walls, and about 20 feet out over adjacent lawns. This spray also controls clover mites.

The author: Dr. George F. Knowlton is extension entomologist.

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Cutworms Let's Control Them

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George F. Knowlton
Extension Entomologist

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MOST cutworms hide in the soil by day and come to the surface of the ground to feed during warm evenings and nights. When found in the soil, the larvae usually are coiled.

They get their name from their habit of cutting off plants at or near the ground level.

Whenever cutworms begin to eat off your flowers, young beets, tomato or cabbage sets, or other vegetable plants, you need to apply control measures promptly. A severe cutworm infestation often causes extensive damage in just two or three nights of feeding. In particular —watch and protect spring transplants.

Under Utah conditions in the spring, cutworms most commonly damage young tomato, sugar beet, bean, corn, squash, cantaloupe, cucumber, melon, potato, lettuce, and bedded flowering plants. Some cutworms produce a second generation in summer, or have larvae large enough in fall to cause crop injury. Climbing cutworms in orchards climb fruit trees and destroy buds and blossoms in early spring.

Appearance: Cutworms are nearly smooth, plump caterpillars (see cover) of many colors and kinds. Each is the larva, or young, of a different kind of stout, dull-colored, night-flying moth (family Noctuidae). The destructive yellow striped armyworm, army cutworm, and corn earworm all belong to the cutworm family. Cutworms of most kinds grow to a length of from one inch to one and one-third inches before completing larval growth. Meantime, each may have fed upon and damaged a number of plants.

CONTROL

Look for cutworms in the soil as you dig or plow your garden in the spring. Watch for them as you work the soil on your farm, and in litter about trees in the orchard. If cutworms are present, bait or apply an insecticide before plants are set out or before the seeds are planted. If the garden or crop already is planted when cutworms are found, spray, dust, or bait promptly to kill the cutworms.

Dust: Dust garden soil with 10 percent toxaphene or DDT dust at the rate of one-half pound to each 1,000 square feet. If you are growing

a field crop, such as sugar beets or corn, apply 25 to 30 pounds of dust per acre. Power dusting is preferred for large fields. However, metal hand dusters are adequate for most home gardens. For the most effective cutworm control do not irrigate or otherwise disturb the soil for a few days following dusting. Should the cutworms be of a type which feeds below the surface, such as the pale western cutworms in dryland grain fields, the insecticide should be worked into the upper inch of soil.

Spray: If you have a good sprayer and prefer to spray, mix 2 ounces (6 level tablespoonfuls) of 40 or 50 percent toxaphene or DDT wettable powder in each 2½ gallons of water. Use this amount on each 1,000 square feet of soil surface. If you use a compressed air hand sprayer, shake the equipment occasionally to prevent the spray materials from settling to the bottom of the tank.

An emulsion material, although easier to use in hand sprayers, may not remain on the surface to kill cutworms as well as the wettable powder or dust.

For large acreages of alfalfa or small grains in the early growth stage, apply 6 to 8 ounces of actual dieldrin (1 quart to 1⅓ quarts of 18 percent emulsifiable concentrate) per acre. For pale western cutworm control on dryland wheat use four ounces actual endrin or 1½ quarts of dieldrin per acre, harrowed in after spraying.

Bait: If bait is used, spread it on a warm evening before planting. If cutworms are still found, re-bait a few evenings later.

A 3 percent toxaphene-bran bait is made by thoroughly mixing 1½ pounds (2½ quarts) of coarse bran with 2 ounces (6 level tablespoonfuls) of 40 percent toxaphene wettable powder, stirring continuously. Then moisten by sprinkling (do not pour) with water, while mixing, to make a crumbly bait. Do not get the bait too wet. Bait gives best kills when spread during warm evenings! Use ½ pound to each 1,000 square feet, or 20 pounds per acre.

Commercial or other formulas of cutworm and grasshopper bait applied in spring when the land is bare, or as needed, generally will be effective in killing cutworms.

CAUTION

Do not spray or dust lettuce, strawberries, or other parts of plants soon to be eaten, with toxaphene, dieldrin, or DDT. These insecticides leave a persistent residue, objectionable on food for man, dairy cows, and animals being fattened for slaughter. Always use care in application. Follow the safety regulations suggested on the printed container label of the insecticide.

CUTWORM BIOLOGY

Noctuid moths, the adults of the cutworms, lay their eggs on grass and weed stems and leaf sheaths, or on bare ground. Some moths lay as

Fig. 2—Adult army cutworm moth, dark form.

many as 1500 eggs. Young cutworms usually emerge in from 2 to 14 days. Most cutworms pass the winter as partly grown larvae in the soil or under logs, trash, manure, or similar materials. Feeding and growth occur in spring, followed by pupation in hollowed-out earthen cells. Moths lay eggs soon after emerging from the soil. Most injurious species have only one generation a year. A few have two or rarely three generations during the season. Cutworms of some species may be found throughout the year. Eggs of the pale western cutworm pass through the winter and hatch early in spring. Their larvae remain beneath the soil surface, eating through and killing the grain plants as they move along the drill rows.

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TO TUBERWORM CONTROL

George F. Knowlton
Extension Entomologist

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THE TUBERWORM bores into the potato tuber leaving tunnels which become brown and corklike. Where infestation is heavy, often a fourth to a half of the potato must be cut away because of these tunnels. Damage from tuberworm infestations is so serious in many warmer parts of the United States that the Utah State Department of Agriculture excludes the shipment of potatoes into Utah from infested areas. It also prevents shipment of potatoes from infested to noninfested areas in Utah.

It is important for growers in quarantined areas to eliminate the worm. It is equally important for growers in parts of Utah where the worm is not present to avoid its introduction.

Control

Control of the tuberworm is neither simple nor easy. However, by means of a combination of cultural practices, spray or dust applications, fumigation, and control in storage, the tuberworm may be effectively controlled, and may be eliminated from infested areas.

Cultural control

1. Plant seed pieces that are not infested.

2. Do not plant the late potato crop adjacent to early plantings. Infestations are more common and severe where both early and late potatoes are grown in the same area.

3. Eradicate any volunteer potatoes early.

4. Cultivate so as to keep the soil hilled against the plants. Always have at least two inches of soil over the tubers throughout growth. This is important to prevent egg-laying moths from reaching the tubers.

5. Harvest as early as possible after potatoes reach maturity.

6. After digging, do not leave tubers or sacked potatoes lying in the field overnight. This leaves them exposed to the night-flying moths.

7. NEVER cover piles of potato tubers, bagged or otherwise, with potato vines. This

permits infestation by partly grown worms. Tuberworms quickly move from wilting infested vines to the tubers.

8. Feed or destroy all infested and cull potatoes by early spring. Do not leave them in the field, around the sorting shed, or in storage.

Sprays and dusts

1. Apply 20 to 35 pounds of 5 percent DDT dust, or 2 pounds of DDT 50 percent wettable powder as a spray in 100 gallons of water per acre. Treat when growth is 8 to 10 inches high.

2. Repeat this treatment 12 to 14 days later.

3. Two weeks before harvest, thoroughly clean out and spray all storage areas and sorting sheds with DDT 50 percent wettable powder. Use at the rate of 4 pounds per 100 gallons. Apply the spray liberally to walls, ceiling, floors, and to all partitions.

4. Used burlap bags should be fumigated or steam cleaned just before they are moved from any area where the tuberworm occurs.

5. Tubers intended for seed should be dusted with one-fourth pound of 2 percent DDT dust per 100 pounds of potatoes, or stored in DDT-treated bags.

Fumigation

1. Fumigate all seed potatoes from infested areas just before planting. As a control measure, fumigation is recommended wherever infestations occur in stored potatoes.

2. When the temperature is 75 degrees F. or higher, fumigate with 2.4 pounds methyl bromide for each 1,000 cubic feet of space, with an exposure period of at least three hours.

3. Where the temperature exceeds 70 degrees F. in a sealed chamber, use a dosage of at least 2 pounds of methyl bromide per 1,000 cubic feet of space for 2 hours or longer, before shipment. This is required under the current Utah State Department of Agriculture quarantine regulations.

4. In an airtight fumigation chamber, 2 pounds of methyl bromide may be used per 1,000 cubic feet when the temperature is above 65 degrees F. The duration of fumigation must not be less than 3 hours.

CAUTION: Operators working with methyl bromide fumigants should wear a gas mask. This should be provided with a canister that will absorb this gas. Read the directions carefully and follow the safety precautions on the label of the insecticide container.

Control in storage

Market potatoes at time of digging if practical. Otherwise store at temperatures below 52 degrees F.

Life History

Tuberworms pass through the winter as larvae in potato tubers in storage and in tubers beneath the soil surface which do not freeze sufficiently to decay. Some larvae and pupae also survive the winter in cellars, adjacent to sorting sheds, and in the field, if protected by rubbish or soil. Breeding and development occur whenever temperatures are high enough to permit insect activity.

Adult moths emerge in the field, from storage cellars, and from cull potato litter about packing sheds. Each female may lay 100 to 300 tiny, oval pearly-white eggs.

The tiny larvae tunnel into leaves and stems. They attack any exposed tubers, often entering at the "eyes." Mature larvae are creamy-white, pink, or green with a dark brown head.

The pupa is contained in a ½ inch long cocoon. Tiny silver-gray moths emerge from these in 7 to 10 days.

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control sheep ked

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George F. Knowlton
Don W. Thomas
Russell R. Keetch

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THE SHEEP KED *(Melophagus ovinus)* is common on sheep throughout Utah. It crawls over the skin and through the wool of the sheep, causing irritation and itching. Tufts of wool hanging on wire fences are a good sign of keds. Animals rub, scratch, and bite to relieve the irritation. To feed, the ked pierces the skin of the sheep and sucks the blood and lymph. When infestations are severe animals appear unthrifty and anemia may be present. Fleece yields on infested animals may be reduced 10 to 25 percent in value. Animals sold for meat have lower market value.

Keds move readily from ewes to lambs. Damage to lambs is particularly serious. Ked infestations cause lack of growth, unsatisfactory fattening, and lowered vitality.

The sheep ked was formerly called a tick. However, it is not a true tick, but a degenerate wingless fly. Keds vary in size; the mature females are about one quarter inch long. The adults are brown, wingless, and possess a leathery, sac-like abdomen. The legs are spread widely and are moderately thick. The maggot, which matures in the body of the mother, is deposited as a whitish, oval, legless individual. This is cemented to the wool where pupation takes place. After 20 to 25 days in summer, adult keds emerge from the pupal cases, which

Insecticides for

Spray formulas
BHC (gamma)
12 percent wettable powder
6 percent wettable powder
Lindane
20 percent emulsifiable concentrate
25 percent wettable powder
Toxaphene
60 percent emulsifiable concentrate
40 percent wettable powder
Malathion
57 percent emulsifiable concentrate
25 percent wettable powder

have turned brown. Pupation may last from three to six weeks in colder weather. Keds breed throughout the year. They spend their entire life on the sheep.

Females live for three to four months and produce 12 to 20 young. Males have a shorter life.

Control

The sheep ked can be effectively controlled by dips, sprays, or by dusting. Keds are more effectively controlled in the spring immediately after shearing; fall treatments require larger amounts of insecticide and are less effective because of the long fleece. Dips and sprays should be used when the weather is warm. All sheep in a herd or on a range should be treated at the same time so that untreated sheep will not reinfest those that have been treated.

If early slaughter is planned, spray the sheep with malathion. Lindane or toxaphene should not be used nearer than 30 days before slaughter. The spray to use will depend to some extent on cost.

Ground derris or cube root (of at least 5 percent rotenone strength) affords an inexpensive and effective control of this pest in fall. Always mix the dry rotenone powder with some water to form a paste. Add 1 pound of household de-

ep ked control

Insecticide per	
100 gallons	**3 gallons**
3 pounds	1½ ounces
6 pounds	3 ounces
1 quart	½ ounce
1½ pounds	¾ ounce
3 quarts	1½ ounces
10½ pounds	5 ounces
1 gallon	4 ounces
16 pounds	½ pound

Dip formulas	Insecticides per 100 gals.
Rotenone	
5 percent ground root	¾ pound
BHC (gamma)	
12 percent wettable	1½ pounds
6 percent wettable	3 pounds
Toxaphene	
40 percent wettable powder	5¼ pounds
Lindane	
25 percent wettable powder	12 ounces

tergent for each 100 gallons of mixed spray in the dipping vat. Thoroughly mix the materials before dipping. The detergent aids penetration of the insecticide into the fleece. No slaughter restrictions are imposed when rotenone is used on sheep.

Dust formula

Dieldrin 1½ percent commercially prepared dust containing 2 percent light oil and in a pyrophyllite carrier

Dusting is an excellent method of controlling keds when adequate power equipment is available for treating large flocks. With well-arranged pens and chutes, 2,000 to 3,000 sheep may be dusted per hour. There need be no concern about chilling following the dust application. Cost for insecticide is low per animal treated. Arrange the chutes so the breeze blows the dust away from the operators. Apply 2 ounces of the prepared dieldrin dust per animal for farm flocks if treated in fall.

NOTE: It may be desirable to change to a different insecticide every few years.

CAUTION: When dusting wear respirator mask and avoid excessive exposure to dust. Remember that both rotenone and DDT are poisonous to fish. In emptying vats, therefore, take care to prevent the material from flowing into fishing streams or ponds. In disposing of used dips do not allow pools to form from which animals may drink or let the dip drain upon vegetation on which livestock are permitted to graze.

° ° °

The authors: George F. Knowlton, extension entomologist Don W. Thomas; extension veterinarian, and Russell R. Keetch, extension sheep specialist, Utah State University.

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ALFALFA WEEVIL CONTROL

Utah State University - Logan
Extension Service
Leaflet 54

JUL 6

Alfalfa Weevil Control

GEORGE F. KNOWLTON
Extension Entomologist

THE ALFALFA WEEVIL is essentially a pest of first crop alfalfa. The adult weevil causes little damage. It is the larvae that feed first within the growing plant tips, then as they grow larger, they feed more and more on the opened leaves. These soon become skeletonized, dry, and take on a grayish to whitish cast which is characteristic of economic damage. Most serious damage to the alfalfa crop occurs in late May or early June.

Cutting the first crop of alfalfa for hay will interrupt weevil development and destroy most of the eggs, larvae, and pupae before they mature. If the crop is not cut, weevil damage will continue to increase. This often results in loss of one cutting of hay and reduces the yield and delays the maturity of alfalfa left for seed.

Description

The adult weevil is a snout beetle about three-sixteenth inch long which varies in color from brown to black. Usually alfalfa growers are unaware of its presence, except on warm spring days when the beetles sun themselves on the tops of alfalfa plants.

The weevil egg is tiny, oval, and lemon yellow, becoming darkened as hatching approaches. At first eggs are laid in dead stems on the ground. When spring growth of alfalfa is about 6 inches tall, the beetles gradually shift their egg laying to growing stems.

Newly hatched larvae are yellow with shiny black heads and are about 1/20 inch long. When full grown they are 3/8 inch long and green with a dark brown head and a conspicuous white stripe down the middle of the back. After feeding on the alfalfa leaves they drop to the ground and spin a white, oval, netlike cocoon among fallen leaves or other debris. The adult emerges from the cocoon.

The alfalfa weevil spends the winter chiefly in the adult stage. Soon after the snow covering has melted in the spring, females become mature and begin laying eggs. They lay an average of 400 eggs. Hatching of eggs in large numbers does not begin until about May 1 or later in the cooler valleys. Once hatching is well started, larvae increase rapidly. They feed ravenously on alfalfa buds and leaves. About May 15 the first larvae become full-grown and spin their cocoons.

Control

Most of the adult weevils in an alfalfa field are produced as a result of the way the field is managed. Migration is unimportant once the stand is established. Weevil control is, therefore, an individual field problem. Good control cannot be nullified by the actions of neighboring growers as is often the case in the control of other insects.

The best way to prevent alfalfa weevil damage is to kill the over-wintered adults early in the spring before the females have laid many eggs. If spring treatment is properly applied, no further treatment is necessary during the season.

If the spring treatment is omitted or applied too late, weevil larvae may become numerous enough in late May or early June to cause damage. This damage should be prevented by an insecticide application to kill the larvae. This treatment may be the same as the bud stage treatment for lygus on the alfalfa seed crop.

Early spring treatment when growth is ½ to 2 inches long

Spray: 1 pint heptachlor or dieldrin in 6 gallons of water per acre

Dust: 5 ounces of heptachlor in 10 pounds of dust per acre

Late spring when control treatments were not made in early spring (late May or early June)

Dust or spray: (per acre)

1. ¼ pint (1 ounce) of heptachlor, or

2. 1 to 2 quarts of 25 percent emulsifiable methoxychlor concentrate, or,
3. 1 pint of 25 percent emulsifiable (4 ounces) parathion, or
4. ½ pint (2 ounces) of aldrin, or
5. 1 to 2 ounces of lindane

CAUTION: If parathion is used, apply with power machines in strict accordance with directions and safety warnings listed on the manufacturer's label. Wait 15 days after treatment before cutting hay treated with parathion, aldrin, or lindane. Wait at least 3 days before harvesting heptachlor-treated hay. Do not feed alfalfa from crops treated with DDT to dairy animals, to animals being fattened for slaughter, or to poultry. If you apply dieldrin for early season control of alfalfa weevil adults, do not allow dairy animals or animals being finished for slaughter to graze the alfalfa until after the first cutting. When you apply heptachlor, do not permit grazing for 10 days.

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Fig. 2—Spreading soil over the gravel in an "artificial" alkali bee nesting site

some soils simple compaction by heavy machinery may be enough. In others a layer of clay packed 2 or 3 feet below the surface may do a good job. With a suitable soil, a hard-pan layer, and a water supply, the next step is to construct a series of blind parallel ditches to grade and run water through on a schedule that will keep the whole area moist, especially during June, July, and August.

In naturally saline soils, subirrigation will usually increase surface salinity to the desired level. If salt does not appear at the surface, granulated stock salt should be mixed into the top 2 inches at the rate of about 9 pounds per square yard to help draw moisture to the surface.

It is also possible to build permanent nesting sites by making excavations 3 feet deep, lining them with 0.008-inch polyethylene or 0.006-inch vinyl film and then backfilling with a 1-inch bed of soil, a 6-inch layer of gravel, and 2½ feet of fine sandy loam (in most cases the native soil). Water can be applied through pieces of tile or pipe extending from the soil surface to the gravel layer. One watering in June usually lasts all season. Salt should be added as described above. A

shallow bed attracts nesting bees as well as a deep one, but more frequent watering is required. The size of such beds depends on the amount of alfalfa to be pollinated and the resources of the growers concerned. A cooperating group of seed growers in northeastern Oregon is now building about 50 large alkali bee sites of this nature.

Colonize the Sites

Newly created areas can be colonized by installing undisturbed blocks of soil taken in the fall or spring from existing sites. Steel cylinders about 12 by 12 inches and slit open on one side, are driven into an established breeding site and pried loose with a plug of soil enclosed. At the new site the cylinder is opened slightly to release the plug into a

Fig. 3—Unearthing soil plugs containing alkali bee nests

prepared excavation. From 25 to 50 plugs should be used to establish a new colony.

When existing sites are protected and plenty of forage is available, the bees usually increase and move into new areas of suitable ground within a mile or so of their old sites.

Simultaneous programs of protecting existing sites and creating new areas favorable for

Fig. 4—Installing soil plugs containing alkali bee nests

nesting have paid off well in Wyoming, Idaho, Oregon, and Washington. The same practices should be profitable in Utah.

Timing the Crop

Seed growers should attempt to bring their alfalfa into bloom when alkali bees are most active, normally from mid-July through early August. In most areas this can best be done with a delayed first crop or an early second crop.

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